



## Director's Statement

Fiscal Year 1997 was another excellent year for the Johnson Space Center. We made significant progress in our programs, continued the transition to our lead center responsibilities and strengthened our partnerships with other space-faring nations, other NASA centers and the community.

Our continued presence on the Russian space station Mir has provided a strong foundation for the International Space Station. We have learned much about living and working for extended periods in an orbiting laboratory. Consistent with our tradition, the difficult times aboard Mir were overcome with hard work, dedication and ingenuity.

The year marked the beginning of hardware delivery for the International Space Station. Planning continued for the launch of the first station element in 1998. The Space Shuttle demonstrated its capabilities with eight very successful launches. The transition of space flight operations to United Space Alliance, the contractor assuming that responsibility, is going very well.

We continued to make significant gains in our advanced technology efforts. Chamber tests demonstrating the feasibility of advanced life support systems, successes of the X-38, advances in robotics and the development of advanced operations concepts are just a few examples of the technical strengths of the Johnson Space Center's people. Our emphasis on multiple applications of our technologies is a significant step toward setting the stage for future exploration initiatives.

Impressive scientific efforts included research aboard Mir and the Space Shuttle. With the establishment of the Space Biomedical Research Institute in March, we formed a powerful partnership that will help us complete the research necessary to put humans in space and on the surfaces of other planets for extended periods.

Across the Johnson Space Center, we continued to demonstrate the breadth and versatility of our workforce and our facilities. We continued to strive for efficiencies in operations, consolidate support activities and demonstrate new and better ways of getting our jobs done. The White Sands Test Facility continued to show its world-class expertise with an outstanding year of performance.

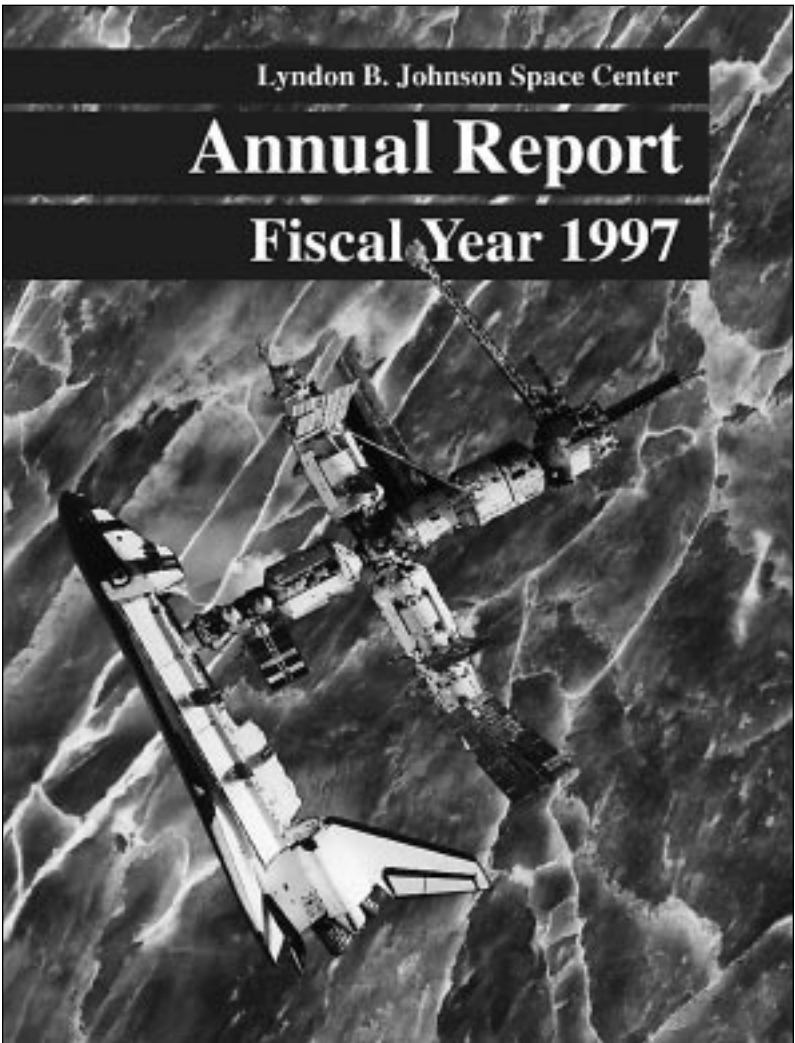
Our efforts to work with the community and to open the center to the public and to business leaders were met with enthusiasm. Our Open House and NASA Johnson Space Center Inspection set attendance records. Our 'Longhorn' cooperative education project reflects the community's past as well as its future. We have made commendable progress, across the board, in our efforts to build mutually beneficial relationships with our constituencies.

We also made a number of internal investments that will pay great dividends. Our efforts to improve safety and our activities to attain ISO 9001 registration are examples of activities that have required hard work and dedication now in return for substantial future benefits.

Above all, FY 1997 demonstrated again the exceptional talent, the unmatched dedication and the unparalleled commitment of our people. Their accomplishments exemplify the spirit of exploration that will carry the nation and the world forward.

I am pleased to present the FY 1997 Annual Report of the Johnson Space Center. The report covers the Center's activities from October 1, 1996, through September 30, 1997. I am proud of the Johnson Space Center's many accomplishments in FY 1997.

George W.S. Abbey



## Operations

FY 1997 saw eight successful Space Shuttle launches. They included the fifth, sixth and seventh missions to dock with the Russian space station Mir in preparation for assembly and operation of the International Space Station.

Representatives of the nations collaborating on the International Space Station met in Houston to finalize the station's assembly sequence. The first two U.S. components of the space station were successfully pressure tested, and the first scheduled for launch, a connecting module called Node 1, was shipped to the Kennedy Space Center to begin launch preparations.

Training facilities continued to be upgraded, and the Neutral Buoyancy Laboratory, an underwater, zero-gravity training facility, was formally dedicated.

**Space Shuttle**  
STS-80, the first flight of the fiscal year, was launched November 19, 1996. The eighth launch of FY 1997, STS-86, left the pad September 25, 1997 ....

**International Space Station**  
The International Space Station began moving from the factory floor to the launch site in FY 1997. The first U.S.-built element of the station, a connecting module called Node 1, was shipped from a manufacturing facility at the Marshall Space Flight Center to the Kennedy Space Center to begin launch preparations.

Node 1, scheduled to be launched aboard the Space Shuttle *Endeavour* on flight STS-88 in 1998, is connected with the Functional Cargo Block, a U.S.-funded control module being built by Russia to be launched a few weeks before Node 1.

Those launches will begin a 45-flight, five-year orbital assembly sequence for the Space Station. Many other station elements passed major construction and development milestones in FY 1997.

In March, milestone critical design reviews were completed for the Functional Cargo Block; Node 1; the Service Module, the first fully Russian

contribution to the station, which will serve as the initial crew living quarters; the Z1 truss, an early exterior framework that will hold communications equipment and gyroscopes; the first solar array module; the Japanese laboratory; and the U.S. laboratory ....

Astronauts who will build and fly on the Station began training for their missions. The Shuttle crew for *Endeavour's* STS-88 flight was named early in the year. To allow for much longer than normal training time required to fully prepare for the unprecedented spacewalking work for the Station's assembly, NASA named 12 astronauts who will perform that work on the first six assembly missions. In Star City, Russia, and in Houston, the international crew that will first occupy the Station began training.

**Mir**  
The three Shuttle missions to Mir during FY 1997 were part of a program called International Space Station Phase 1. Begun in March 1995, Mir hosts a series of NASA astronauts as crewmembers. During all of FY 1997, one of the

crewmembers aboard Mir was a NASA astronaut ....

NASA and Russian engineers, designers, technicians, and flight crews work together to achieve a common goal by making many practical decisions on a daily basis, melding their different work styles into a unified plan. Shuttle-Mir is a complicated interlocking program incorporating the very different working styles and philosophies of the U.S. and Russian space agencies and their international partners.

FY 1997 saw a number of challenges associated with Mir ... Through cooperation, innovation, dedication and hard work, Russian and U.S. astronauts and ground support personnel worked through those challenges, setting new precedents in international space cooperation.

**Astronaut Training**  
As FY 1997 ended, the selection process for 12 astronauts to begin intensive training in preparation for construction of the International Space Station was in its final stages ....

## Research and Development

Research and development projects at the Johnson Space Center during FY 1997 continued to provide a technological base to carry out the missions of NASA and the Center and to meet the goals of the Human Exploration and Development of Space Enterprise.

**Aerospace medicine and biomedical research at the Center covered a wide spectrum, including an advanced cell-culture device mimicking the effects of microgravity, a miniature pump based on technology used for the Space Shuttle's main engines and designed to assist the human heart, and advanced biomedical monitoring techniques.**

*Among highlights was initial development of the X-38, which could become a crew return vehicle for the International Space Station and perhaps serve as a technological base for development of the first new crewed spacecraft in more than 20 years.*

*Another project saw volunteers complete a 60-day test of the Advanced Life Support System concept, a human life support system designed to supply food, water and oxygen and operate indefinitely in space without resupply from Earth. Another such test for 90 days was begun in FY 1997 and concluded successfully in December.*

**Aerospace Medicine and Biomedical Research**  
A series of ongoing projects use the unique conditions of orbital space

microgravity and the capabilities of Johnson Space Center researchers. Ongoing projects include

- ◆ A system to grow cells in three dimensions, similar to the way they would grow in the microgravity of space, is leading to advances in medical research. Called the Rotating Wall Bioreactor, it could lead to improvements in treatment or prevention of a variety of diseases, including diabetes, cancer and AIDS.
- ◆ Advances in turbopump technology required by the Space Shuttle's main engines have resulted in development of a very small heart pump. Johnson Space Center scientists and a team led by Baylor College of Medicine's Dr. Michael DeBakey developed the Ventricular Assist Device to assist the human heart ....
- ◆ A compact device for monitoring vital signs from a sensor inside the ear canal is under development. Called the Intra-Aural Probe .... Possible public uses include monitoring in ambulances, in aircraft or for firefighters.
- ◆ Developed at the Johnson Space Center, Telemedicine was initially used to monitor the health of astronauts during space flight. It is now used to help physicians evaluate and treat patients remotely.

**The X-38**  
Unpiloted flight testing of the X-38, a prototype that could become the first

new human spacecraft to travel to and from orbit in the past two decades, began during FY 1997. The spacecraft was designed by engineers at the Johnson Space Center working toward a vehicle that could become operational at a fraction of the cost of past human spacecrafts.

The innovative X-38 project's goal is to assemble a prototype crew return vehicle for the International Space Station. But the X-38 concept could be modified for other uses, such as a possible joint U.S. and international human spacecraft that could be sent into orbit ....

**Advanced Life Support System**  
The human life support system could prove to be a vital element in long-duration space flight. The successful 60-day test of the Advanced Life Support System concept and the subsequent 90-day test, also with four volunteers, were parts of what is called the Advanced Life Support Test Project.

The life support system used in the 60- and 90-day tests reuses liquids and solid materials. Only energy is added. It is perhaps the ultimate in recycling and regeneration and could supply crewmembers with food, water and oxygen indefinitely ....

**The TransHab**  
A new design concept for a habitation element for lengthy space missions was unveiled during FY 1997. The

concept could be developed as a habitation (or perhaps laboratory) module for the International Space Station, used as a vehicle to carry humans on long-duration space voyages to other planets, and used as a habitation module on the surface of other planets or on the moon.

Called the TransHab, it is a hybrid combining a hard central core with an inflatable outer shell. Its volume would be about twice that of the Space Shuttle cargo bay ....

The TransHab design calls for it to be launched deflated in the Space Shuttle's cargo bay. Once in orbit, it would be inflated to its full volume and its interior configured for its specific mission ....

**Continuing R&D**

- ◆ Research on materials in space-like vacuum and temperature extremes
- ◆ Tests of hardware under simulated vibration and acoustic conditions of various phases of space flight
- ◆ Development and tests of spacecraft communications systems in the Anechoic Chamber Test Facility, which simulates the nonreflective electromagnetic environment of space
- ◆ Advanced space suit research
- ◆ Robotics related to human space operations
- ◆ Utilization of resources on bodies like the moon and Mars

# Fiscal Year 1997 Highlights

Fiscal Year (FY) 1997, from October 1, 1996, to September 30, 1997, was a period of accomplishment for the Johnson Space Center in operations, research and development, commercialization of space and in growing relationships with the community.

Among the year's highlights:

- ◆ The successful launch of eight space shuttle missions, including three to the Russian space station Mir.
- ◆ Continued progress on the International Space Station, with shipment of the first U.S.-made component to the launch site and agreement of the international partners on an updated assembly schedule.
- ◆ Growth of the Johnson Space Center's responsibilities in assuming lead center role for space flight operations.

- ◆ Broadening of the Center's role in space, in the Shuttle-Mir program and especially in International Space Station activities.
- ◆ Advances in a number of technologies, including the concept for the first new crewed spacecraft in more than 20 years and advanced life support systems.
- ◆ An increased focus on commercialization of space, with an increase in interest from the private sector.
- ◆ Outsourcing of operations through consolidated contracts in favor of research and development and core competencies.
- ◆ Adoption of the Johnson Space Center Quality System, based on the ISO 9001 standard and leading to ISO 9001 registration.
- ◆ The annual Safety and Total Health Day emphasizing the Center's safety focus.